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Radiofrequency Ablation Used to Treat Liver Metastases

■ BETHESDA, Md—Radiofrequency ablation (RFA) is being used to "cook" tumors where they lie and may be particularly useful for destroying liver metastases. This quick, nontoxic, relatively noninvasive approach will soon be tested in clinical trials, Bradford Wood, MD, of Georgetown University Medical Center and the National Institutes of Health, said in an interview.

Dr. Wood noted that his work "is a relatively new application of an old technology—hyperthermia." The main problem with RFA tumor ablation in the past has been the small volume of tumor, about 1.5 cm in diameter, that could be destroyed with each treatment.

"Now we are able to ablate volumes up to about 5 cm with a single probe placement, and we can do multiple treatments. Each clears a small sphere of tumor tissue, and we can add up these spheres to create a larger sphere," Dr. Wood said.

A single probe destroys 5 cm of tumor tissue

To perform RFA, a needle electrode that has an insulated shaft and an uninsulated tip is inserted into the lesion, using imaging guidance—most often ultrasound, but also CT or magnetic resonance imaging (MRI). Grounding pads on the patient's thighs or back muscles make the patient into an electrical circuit. The energy released at the uninsulated tip causes ionic agitation and frictional heat, which leads to cell death and coagulation necrosis.

"RFA also cuts off the blood supply to

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the tumor," Dr. Wood said. "This partly explains the low complication rate (less than 2%). As the needle is removed, it cooks along the needle track, which stops needle track seeding and bleeding." The technology is similar to surgical electrocautery, used to stop bleeding during surgery for more than 50 years, he added.

Over the months following RFA, fibrosis occurs in the ablated area, and the "cooked" tumor typically shrinks. Stable or shrinking lesion size is taken to indicate the absence of active disease.

However, technical problems in follow-up imaging remain to be solved. "RFA leaves a little rim of hyperemic tissue around the treated site," Dr. Wood said. "This is difficult to differentiate from residual tumor at the margin using current methods." His group is exploring the use of MRI and positron emission tomography (PET) for follow-up after RFA tumor removal.

Dr. Wood and his colleagues are working with two types of RFA. In the coaxial expanding method, inner needles or hooks come out of the hollow needle electrode like an umbrella after insertion into the tumor (see Figure 1). Dr. Wood said that this approach is preferable for lesions that move with breathing.

There are two types of needles used in RFA

The water-cooled method (Figure 2) uses a needle electrode that has a water-cooled tip to prevent "charring" of tissue and three parallel needles to ablate the lesions. Dr. Wood said that this approach promotes the distribution of the frictional heat within the tumor, particularly when the carcinoma is encapsulated.

definitive therapy for solitary liver tumors remains surgical resection, but such surgery is not an option for some patients. Dr. Wood said that only about 20% of patients with liver metastases of colorectal cancer are candidates for resection and that two thirds of those operated patients will have disease recurrence within 5 years. The other 80% of patients are inoperable for medical reasons or have unresectable lesions.

"We are very limited in what we can do safely with surgical resection," Dr. Wood said. "We cannot use surgery to treat huge tumors or large numbers of micrometastases." Patients with two to five tumors are not generally considered candidates for surgery, he said, but RFA can sometimes be used to remove or reduce hepatic tumors in such patients.

Another use is in the patient who is inoperable due to diffuse disease, such as lesions in both left and right lobes of the liver.

"Many of these patients are considered inoperable by conventional approaches," Dr. Wood said, "but we can sometimes convert such a patient to a candidate for surgery by using RFA to ablate

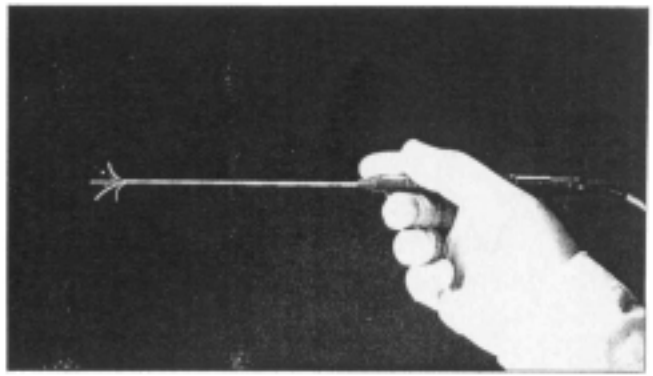

Figure 1. A coaxial expanding needle electrode used in radiofrequency ablation. After insertion into the tumor, three inner needles or hooks expand out of the hollow needle like an umbrella. Photograph courtesy of Rita Medical Systems Inc., Mt. View, California.

Patients with liver metastases typically have normal (soft) underlying hepatic parenchyma, whereas the metastasis is hard and infiltrative and more difficult to pinpoint and treat with RFA.

RFA tumor removal has not been tested in prospective, controlled, randomized clinical trials because such trials would be extremely difficult to design, Dr. Wood said.

"We are cautiously optimistic that RFA will provide a useful approach for treating many tumors, but we do know that

Patient Care After RFA

Most patients receiving radiofrequency ablation are discharged the same day as their procedure. Some may require small doses of postprocedure analgesics. Local site tenderness is common, and patients are warned not to use cold packs in the first few hours following the procedure, since this might limit the tumor heating effect. Some mild soreness at the puncture site may persist for a few days.

Patients may experience a low-grade fever for a few days following the procedure and are told to contact their physician for any fever above 100.5° F.

The NIH has an ongoing protocol/trial for RFA of liver tumors that has been underway for several years, and Dr. Wood also performs the procedure at Georgetown University Medical Center and at Massachusetts General Hospital.

Kidney Tumor Trial

The NIH has a new research trial for radiofrequency ablation of kidney tumors in patients with multiple or recurrent tumors, contraindications to surgery, or solitary kidneys.

RFA may be useful in Von Hippel Lindau kidney disease

For example, Dr. Wood said, patients with Von Hippel Lindau disease are predisposed to multiple recurrent renal tumors that eventually require major surgery to be repeated at intervals until ultimately there may not be enough kidney left to function. RFA might provide a way to kill tumor and spare as much normal kidney as possible.

To date, Dr. Wood has performed more than 100 radiofrequency ablation

electrode like an umbrella after insertion into the tumor (see Figure 1). Dr. Wood said that this approach is preferable for lesions that move with breathing.

needles used in RFA

The water-cooled method (Figure 2) uses a needle electrode that has a water-cooled tip to prevent "charring" of tissue and three parallel needles to ablate the lesions. Dr. Wood said that this approach can ablate a greater volume of tissue without charring (overheating at the edges of the needle with inadequate heating at the edges of the treatment sphere).

A number of different sources of thermal ablation have been used in the past, including microwaves, lasers, and high-intensity-focused ultrasound. "RFA may be better than other ablative techniques because it is fast, easy, predictable, safe, and relatively cheap," Dr. Wood said.

Each ablation requires only 12 to 15 minutes and is usually done as an outpatient procedure. Equipment costs include $12,000 to $30,000 for the generator and $500 to $1,000 for each needle used, Dr. Wood said.

The most promising potential use for RFA may be in treating liver tumors. The "Many of these patients are considered inoperable by conventional approaches," Dr. Wood said, "but we can sometimes convert such a patient to a candidate for surgery by using RFA to ablate the lesion on one side, leaving the other side for resection."

He added that primary liver cancer (hepatocellular carcinoma or hepatoma) may respond even better to RFA than colorectal metastases (Figure 3). This is because hepatocellular carcinoma usually occurs in the setting of cirrhotic liver disease. In this situation, the tumor is "soft" whereas the surrounding liver parenchyma is "hard." This produces an oven-like effect that

the first few hours following the procedure, since this might limit the tumor heating effect. Some mild soreness at the puncture site may persist for a few days.

Patients may experience a low-grade fever for a few days following the procedure and are told to contact their physician for any fever above 100.5° F.

Adequate hydration following the procedure is emphasized to limit the possible risk of tumor-lysis-like syndrome, although this problem has not been observed in actual practice. In general, oral fluids are encouraged in the days following the procedure, in the absence of hypertension, congestive heart failure, renal failure, or other fluid management conditions.

such trials would be extremely difficult to design, Dr. Wood said.

"We are cautiously optimistic that RFA will provide a useful approach for treating many tumors, but we do know that the most important determinant of success appears to be the natural history of the individual patient's disease, and this is difficult to predict," he commented.

Dr. Wood emphasized that the success of RFA tumor ablation is heavily dependent on the skill and experience of the interventional radiologist doing the procedure. "This is an image-guided procedure, and accurate placement of the needle determines both safety and results," he said.

The procedure is currently limited to use at specialized centers, including the Massachusetts General Hospital, Georgetown University Medical Center, and the National Institutes of Health (NIH).

Radiofrequency ablation has been approved by the Food and Drug Administration for ablation of soft tissue but not specifically for tumor removal. Dr. Wood said that reimbursement for the procedure should be covered by codes for hyperthermia involving placing the needle into the tumor.

Hippel Lindau kidney disease

predisposed to multiple recurrent renal tumors that eventually require major surgery to be repeated at intervals until ultimately there may not be enough kidney left to function. RFA might provide a way to kill tumor and spare as much normal kidney as possible.

To date, Dr. Wood has performed more than 100 radiofrequency ablation sessions, and more than 10 kidney tumor ablations. ◗

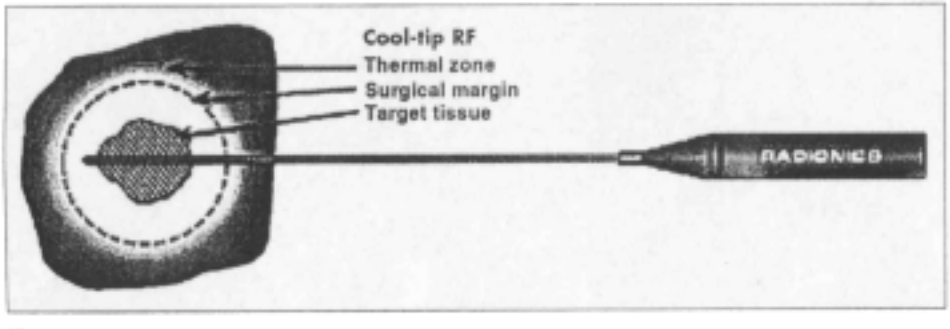

Figure 2. A water-cooled needle used in radiofrequency ablation shown inserted into a tumor. This type of needle prevents charring or overcooking of tissue. Drawing courtesy of Radionics, maker of the Cool-tip RF System.

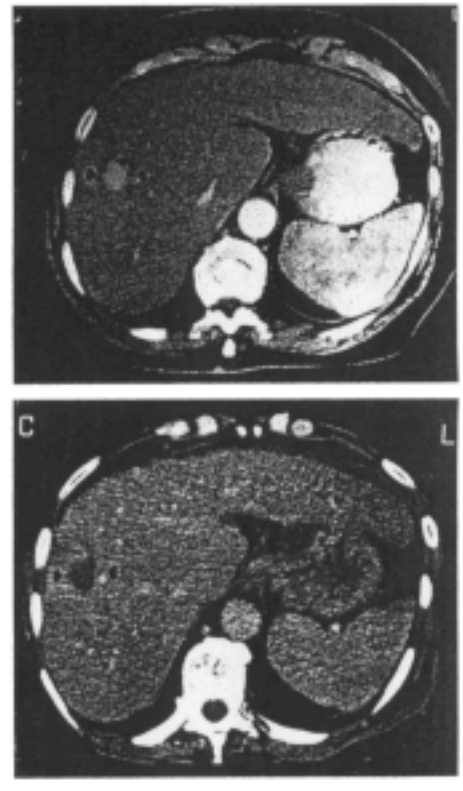

Figure 3. The top image is a pretreatment CT scan showing a primary liver tumor (arrows). The bottom image shows the same tumor after radiofrequency ablation. The dark area (arrows) represents coagulative necrosis. Images courtesy of Rita Medical Systems Inc., Mt. View, California.